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(54) Apparatus for solidifying and processing a molten material

(57) A molten material solidifying and processing apparatus capable of avoiding breakdown of a pulverizer which is designed to pulverize water quenched slag. The apparatus disclosed herein includes a water quenching granulator (3) adapted to water quench and solidify a molten material discharged from a discharge port (2) of a waste material melting furnace (1), a magnetic separator (20) for magnetically selecting water quenched solids discharged from a discharge port (8) of the water quenching granulator (3), a sieve (30) for screening particulates (31) discharged from a discharge port (28) for non-magnetic materials of the magnetic separator (20) to separate into coarse particles (32) and fine particles (33), and a pulverizer (45) for further pulverizing the fine particles (33) discharged from a discharge port (37) for the fine particles, the pulverizer being provided therein with parts made of ceramic for pulverization.

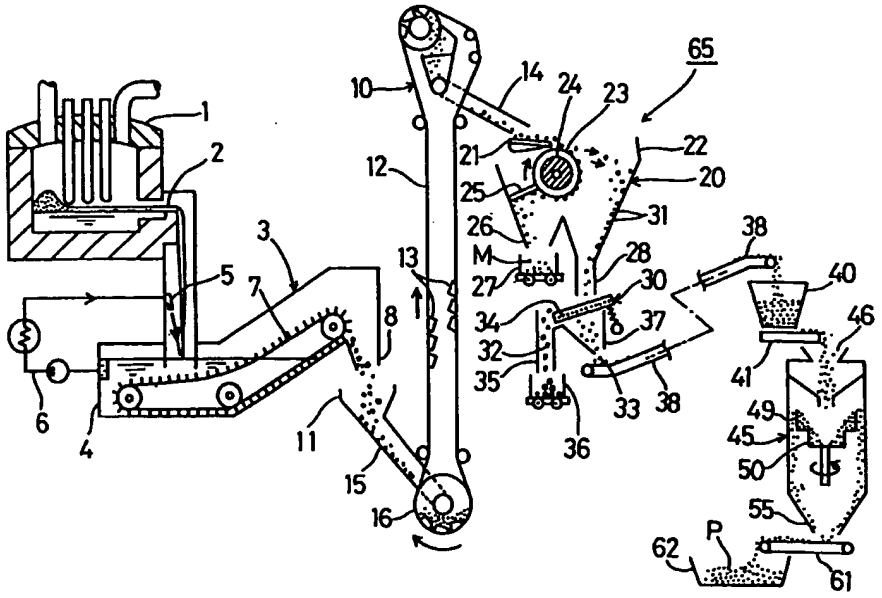

Fig. 1

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Description

This invention relates to a molten material solidifying and processing apparatus which is arranged to solidify and process molten material obtained by melting and processing wastes with a waste melting furnace.

A molten material is generally obtained by melting and processing the ashes of urban and municipal wastes, sewage sludge, industrial waste disposal and the like in the waste melting furnace. For example, the molten material is then cast into a water tank provided in a residue discharger disclosed in Japanese Laid-Open Publication Sho 62-172107 and is water quenched and solidified. Water quenched and solidified material (hereinafter referred to as "quenched and solidified material") obtained in this manner is scraped and delivered by a conveyor. This material is separated into solidified fine particulates (hereinafter referred to as "water quenched metal, or quenched metal") of a magnetic metal component and solidified fine particulates (hereinafter referred to as "water quenched slag, or quenched slag") of an inorganic component, the former being reused in a balance weight of an industrial equipment and the like whereas the latter is reutilized in civil engineering and building materials.

Conventionally, the quenched slag is not only uneven in size,shape thereof and sharply protruded but also is more aciculate so that the slag is required to be cast into pulverizer such as a cage mill or the like and is pulverized, processed therewith. However,the slag is such hard as to be soon worn away if the conventional pulverizer which is equipped with parts of metal for pulverization, for example, pins in case of the cage mill. In order to cope with such wear,the parts for pulverization are made of ceramic instead of metal to this end. Disadvantages derived from use of the ceramic-made parts for pulverization are that, for instance, coarse particle slag of more than 10mm particle size and of high hardness,as well as such coarse particle slag with metal of more than 10-15mm involved therein, which is difficult for selection by means of a magnetic separator after solidifying the coarse particle slag with metal involved therein when quenched and solidified in the tank, if introduced into the pulverizer readily damage the ceramic-made parts for pulverization to thereby require to occasionally exchange expensive parts with each other, thus increasing such cost of maintenance and parts as uneconomical.

When the metal in the coarse particle slag with the metal involved therein is of small size, the quenched slag is likely to mix into the quenched slag so that the latter if used as building and civil engineering materials result in not only formation of rust over the metal to be nonconformation to asphalt and concrete but also expansion and exfoliation thereof.

When the wastes to be processed contains more metal components,the effluent from th furnace is solidified in an icicle-like form and thus discharged as massive quenched metal or, for example, massive foreign matter in addition to th molten material such as pieces of broken sub-electrodes and the like at the discharg port so that bulky matter tend to clog th inlet of th processing equipments such as the magnetic separator and the pulverizer or to enter the machine to cause breakage of the parts for pulverization.

This invention is provided to solve the aforementioned troubles and has an object to provide a molten material solidifying and processing equipment capable of remedying a breakage trouble over a pulverizer or granulator for pulverizing the quenched slag.

Another object of the invention is to provide a molten material solidifying and processing equipment which is adapted to separate into the quenched slag and quenched metal, the water quenched solids from the molten material charged out of a waste melting furnace.

A further object of the invention is to provide a molten material solidifying and processing equipment for preventing a processing equipment from being blocked and broken by bulky matter exhausted from the water quenching granulator.

The invention claimed in Claim 1 provides an equipment for solidifying a molten material from a waste material melting furnace characterized by being composed of a water quenching granulator for a molten material discharged from a discharge port of a waste material melting furnace; a magnetic separator for separate magnetic materials from water quenched solids discharged from a discharge of said water quenching of said water quenching granulator; a sieve for screening nonmagnetic materials discharged from a discharge port therefor in said magnetic separator to separate into coarse particles and fine particles; and a pulverizer for further pulverizing said fine particles discharged from a discharge port therfor in said sieve, said pulverizer being provided therein with pulverizing parts made of ceramic.

The invention set forth in Claim 2 in which there is provided in the invention of Claim 1 a crusher for crushing said course particles discharged port therefor in said sieve, and in which a return passage is provided to return crushed materials discharged from a discharge port in said crusher to a path led from said discharge port of said water quenching granulator to an inlet of said magnetic separator.

The invention called for in Claim 3 in which there is provided in the invention of Claim 1 or 2 a sieve for bulky matter separation is disposed on a path led from said discharge port of said water quenching granulator to an inlet of said magnetic separator.

According to the present invention, various mills such as a cage mill, pin mill, vibrating mill and the like may be used as pulverizers. Preferably, a high-speed centrifugal pulverizer as described in the embodiment hereinafter is fabricated to have no abutment into which the objects to be pulverized are directly smashed,thereby saving the cost of maintenance and

the parts. It is noted that the parts for pulverization in the pulverizer herein referred to thos with and into which the objects to be pulverized ar slidably contacted or smashed.

According to the present invention, a crusher is used to crush the coarse particles slag with metal involved therein and separate the former into the quenched metal and quenched slag. To this end, various crushers such as a jaw crusher, roll crusher an the like may be used.

Fig. 1 is an overall schematic representation showing a molten material solidifying and processing equipment in a vertical section, in which one example of the invention set forth in Claim 1 is embodied;
Fig. 2 is a fragmentary vertical section of the principal part of a pulverizer shown in Fig. 1;
Fig. 3 is an overall schematic representation showing a molten material solidifying and processing equipment,in a vertical section, in which another example of the invention set forth in Claim 2 is embodied;
Fig. 4 is an overall schematic representation showing a molten material solidifying and processing equipment in a vertical section, in which still another example of the invention set forth in Claim 3 is embodied; and
Fig. 5 is an overall schematic representation showing a molten material solidifying and processing equipment in a vertical section, in which a further example of the invention set forth in Claim 3 is embodied;

One embodiment of the present invention as described in Claim 1 will be illustrated hereinafter with reference to the accompanying drawings, wherein a water quenching granulator 3 disposed downwardly of a discharge port 2 in an overflow type,which is formed on a waste melting furnace 1 of an arc type. The water quenching granulator 3 includes a water tank 4, a water supply system 6 adapted to feed return water from the tank to a water quenching nozzle 5 after the water is cooled, and a scraper conveyor 7 arranged in the tank 4 and provided with sweeper or scraper boards run along the bottom of the tank.

The quenched solids which have been scraped with the scraper conveyor 7 are exhausted from the discharge port 8 for quenched solids. Downwardly of the port 8, there is arranged a bucket elevator 10 of an inner bucket type on which a bucket 13 (partially shown)inside a belt l2 is mounted with an inlet 11 oriented to the discharge port 8.In this connection, the bucket elevator l0 is shown in a typical representation with a tower being omitted from the drawings.

A magnetic separator 20 of a rotary drum type is disposed downwardly of an discharg port 14 of the bucket elevator 10 with the top of a vibrating feeder 21 directed to the discharge port l4.The magnetic separator 20 comprises the vibrating feeder 21 within the casing 22, a drum 23 rotatably journaled downstream th feeder, a cylindrical perment magnet 24 mounted inside the drum, and a scraper 25. The scraper 25 is supported at its on end to be in slidable contact with the peripheral of th drum 23 in the direction thereof. The casing 22 is fabricated at its lower end to fork into two segments,the former being provided downwardly thereof with a magnetic material outlet 26 which provide a vessel 27 downwardly thereof to contain magnetically selected water quenched metal M whereas the latter is formed with a nonmagnetic material outlet 28 which includes a sieve 30 thereunder.

The sieve 30 is adapted to separate particulates 31 which consist of quenched slag S, coarse particle quenched slag S with water quenched metal M contained therein, and pieces of broken electrodes and the like into coarse particles 32 and fine particles 33. In this embodiment, vibrating sieving machine with s screen 34 which is of opening size of 8mm is employed. The sieve 30 includes a vessel 36 downwardly of a discharge port 35 for the coarse particles 32 on the sieve to receive the same therein. A discharge port 37 for the fine particle parts is opened upwardly of a conveyor 38 at the one end thereof.

The other end of the conveyor 38 is present upwardly of an opening 40a of a hopper 40 adapted to adjust the amount the fine particle parts to be fed. A charging rate controlling feeder 4l for supplying the fine particle parts in a predetermined quantity is mounted below the hopper 40. A pulverizer or pulverizer 45 is opened at an inlet 46 underneath the charging rate controlling feeder 41 at the forward end thereof.

The pulverizer 45 is what has improved a high speed centrifugal pulverizer which is used in a casting factory to regenerate old or used sand. As shown in Fig. 2, the pulverizer 45 is composed of a cylindrical casing 47 having a charging opening 48 formed thereabove, an annular shelf 49 of L-shaped cross section rigidly the casing 47 downwardly of the charging opening 48,and a rotary dish 50 having its upper flange disposed adjacent the central opening in the shelf 49. The rotary dish 50 is mounted on a vertically extending- rotary shaft 51 which is driven at a high speed by a motor(not shown)via a belt V. An cylindrical member 52 adapted to support the rotary shaft 51 on a bearing is secured by a bracket 54 to a support 53 serving as a belt cover.

The pulverizer 45 is further arranged so that the fine particles 33 in the quenched slag S are charged into the rotary dish 50 and rotated about the vertical axis with subjected to centrifugal force and are then flowed over the rim of the rotary dish 50 and into the shelf 49.The fine particles 33 in the annular shelf 49 are flowed in the direction of the arrow Q from the top of the shelf and backwardly fall on the rotary dish 50 so that a circling stream is formed in the direction of the arrow R to provide friction between the fine particle parts, thereby reducing th latter to particulates in an even form. Th resultant particulates as obtained according to th amount of the fine particles introduced from the charg-

ing rate controlling feeder 41 ar flowed out of th rim of the shelf 49 and then effluent out of an discharge port 55 as slag particles P.

In the pulverizing process, the pulverizing parts such as a bottom liner 56 of th rotary dish 50, a drum edge 57 served as a side liner, a cap 58 over the shaft 51, and a ring edge 59 of the annular shelf 49 those of which are brought into contact with the slag fine particles 33 to be powdered or pulverized are made of hard (but not resistible to shock)ceramic instead of metal which wears in a short time.

As show in Fig.1, the discharge port 55 of the pulverizer 45 is opened above a conveyor 61 which is extended to the top of a pit 62 adapted for storing the slag particles P.

A molten material solidifying and processing equipment 65 as above arranged is designed so that the molten material obtained by melting and processing the wastes in the waste melting furnace is overflown from the discharge port 2 and introduced into the water tank 4. The molten material is further rapidly cooled and water quenched and solidified after subjected to injection water from the water quenching nozzle 5. The resultant solids are then conveyed by the scraper conveyor 7 in the tank 4 and fall from the discharge port 8 into the inlet 11 of the bucket elevator l0.

The quenched solids which have been entered from a charging chute 15 into a loading portion 16 of the bucket elevator 10 and been then upwardly conveyed by the circulated bucket 13 are introduced from the discharge port 14 to the magnetic separator 20. The magnetic separator 20 is functioned to separate the solids, which are supplied by the vibrating feeder 21 to the periphery of the drum 23,into nonmagnetic quenched slag S and particulates 31 other than magnetic quenched metal M in such a manner that the slag S are blown away by centrifugal force from the periphery of the drum 23 rotatable at a relatively high speed,whereas the metal M are solely attracted by magnetic force of the permanent magnet 24 to the peripheral of the drum 23 and scraped off by the scraper 25. The separated quenched metal M are collected from the outlet 26 into the vessel 27.The particulates 31 are discharged out of the discharge port 28 and supplied to the screen 34 of the sieve 30.

The sieve 30 is actuated to screen the particulates 3l thus separating the latter into the slag S each of which is of diameter larger than the opening size of the screen 34, coarse quenched slag with the quenched metal M as involved therein and electrode broken pi ces or the like as coarse particles. The coarse particles 32 are exhausted form the discharge port 35 into the vessel 36. There are provided under the sieve small diametric quenched slag S,and the small diametric quenched slag S and the like with a smaller quenched metal M therein,those of which are discharged as fine particles 33 from a discharge port 37 therefor onto a conveyor 38. The fine particles 33 are carried by the conveyor 38 and pass through a hopper 40 and the charging rate controlling feeder 41 and ar then charged into the pulverizer 45. The charged particulates are pulverized and grain sized adjusted by the pulverizer 45 to slag grains P which ar accumulated in a slag pit 62 as in an even form with no sting-like slag.

In this manner, the pulverizer 45 is adapted to receive therein only the fine particles 33 of a grain diameter less than a predetermined diameter to positively prevent water quenched slag S in large size and the coarse particle slag with quenched metal M therein, and pieces of massive broken electrode and the like from being entered in the pulverizer 45 so that the inlet or the inside of the machine is not blocked out.

Referring to Fig. 3, a further embodiment of the invention claimed in Claim 2 will be described hereinafter,wherein the same numerals and characters are used to designate the corresponding parts in Fig • 1 so that it is deemed not to repeat the description of the same. A molten material solidifying and processing equipment 66 in this instance is different from the molten material solidifying and processing equipment 65 shown in Fig.1 in that there is provided a crusher 70 such as a roll crusher downwardly of the discharge port 35 of the sieve 30, and that the forward end of a return conveyer 72 disposed below an discharge port 71 of the crusher 70 is positioned above an inlet 74 of a return chute 73 in communication with the inside of the loading portion 16 of the bucket elevator 10.The molten material solidifying and processing equipment 66 is also designed in the same manner as in the aforementioned embodiment to prevent the coarse particles 32 in the particulates 31 from being entered into the pulverizer 45 at the same time as the coarse particles 32 are discharged from the discharge port 35 are introduced in the crusher 70 to crush and reduce the water quenched slag S in large size and the pieces of the broken electrode in the coarse particles 32 to those of small diameter. Concurrently,the coarse particle slag with metal therein are crushed to separate the metal from the slag. A crushed material 75 such as a small diametric mixture passes through a return passage 76 which consists of a return conveyor 72 and a return chute 73 and is then returned to the side of the loading portion 16 of the bucket elevator 10. The crushed material 75 is mixed with the quenched solids from the discharge port 8 of the water quenching granulator 3 and is upwardly conveyed and charged into the magnetic separator 20 again. The endomorphic or involved metal which are separated by means of the aforementioned crushing are magnetically selected. On the other hand,the quenched slag S reduced in its diameter by the aforementioned crushing is separated from the endomorphic or involved metal and are then reduced in each diameter thereof. The slag S mostly pass through the sieve 30 and to the pulverizer 45, resulting in grain size adjusting after crushing.

As aforementioned, according to the molten material solidifying and processing equipment 66, upon crushing the coarse particles 32 by the crusher 70 and

magnetically selecting by the magnetic separator 20,th coarse particle slag with the metal involved ther in are positively separated into the quenched slag and the quenched metal so that a recovery percentage of th quenched slag S and th quenched metal M is improved mor than that of the first embodiment.

Although this embodiment has been illustrated and described as embodied in that the crushed material 75 discharged from the discharge port 71 is returned to the loading portion 16 of the bucket elevator 10, the crushed material may be returned by another return passages arranged on the inlet 11 of the bucket elevator 10 or above the feeder 21 of the magnetic separator 20, Leading to a position other than the path for the quenched solids from the discharge port 8 of the granulator 3 to the inlet of the magnetic separator 20.

Referring now to Fig. 4, a further embodiment of the invention called for in Claim 3,will be described, wherein like reference numerals and characters designate like or corresponding parts shown in Fig. 1 so that a detailed description of similar parts will not be repeated.

A molten material solidifying and processing equipment 67 in this embodiment is different from the molten material solidifying and processing equipment 65 shown in Fig. 1 in that a sieve 80 for bulky matter selection is provided between the quenched solid discharge port 8 of the water quenching granulator 3 and the inlet 11 of the bucket elevator 10 and that a vessel 83 is positioned below an discharge port 81 on the right side of the sieve to contain therein bulky matter 82. A vibrating feeding machine with a screen of 30mm opening size is used as the sieve 80 in this embodiment. The screen 84 is located just above the inlet 11 to the bucket elevator 10 followed by the charging chute 15 which functions as the discharge port on the back side of the sieve.

The molten material solidifying and processing equipment 67 as above arranged is adapted,in the same manner as in the embodiment shown in Fig.1,to prevent the coarse particles 32 in the particulates 31 by the sieve 30 from entering the pulverizer 45 at the same time as bulky matter 82 such as the massive quickened metal and the pieces of the broken electrode discharged out of the quenched solid discharge port 8 of the water quenching granulator 3 are separated by the sieve 80 and exhausted from the discharge port 8l on the right side of the sieve into the vessel 83 so that the bulky matter 82 by way of the bucket elevator 10 are prevented from entering the magnetic separator 20 and the pulverizer 45,thereby causing neither blockade nor breakage in the successive processing equipment such as the bucket elevator l0 and the like.

In this alternative embodiment, the sieve 80 is positioned just under the discharge port 8 to separate the bulky matter 82 at an early stage to prevent the latter from entering conveyor means such as the bucket elevator 10 or the like,thereby causing neither blockade nor breakag therein Alternatively, the sieve 80 may be located above the vibrating feeder 21 or intermediately of the conveyor means (for instance,half way between the two conveyors arranged in series),or else may be arranged in such passage other than th path where the quenched solids are conveyed from th discharg port 8 to the inlet of the magnetic separator 20.

Referring now to Fig • 5,still another embodiment of the invention claimed in Claim 3, will be described, where in like reference numerals and characters designate like or corresponding parts shown in Figs.1,3 and 4 so that a detailed description of similar parts will not be repeated. A molten material solidifying and processing equipment 68 is designed so that the sieve 80 similar to the sieve as illustrated in Fig • 4 for bulky matter separation is disposed between the exhaust port 8 and the inlet 1l,and that the vessel 83 for containing the bulky matter 82 therein is positioned below the discharge port 81. This is what differs from the molten material solidifying and processing equipment 66 shown in Fig • 3, viz.,the crusher 70 and the return passage 76 are disposed in the equipment 65 shown Fig.1. The equipment 68 in this instance is arranged in combination with the embodiments shown in Figs.3 and 4 so that operation and result may be collectively obtained from the both embodiments. On the other hand, the bulky matter 82 are separated by the sieve 80 and thus not delivered to the crusher 70 across the passage above the magnetic separator 20 and the sieve 30. For this reason, loads upon the crusher 70 are decreased not only to make possible the use of the crusher in small size but also to further, reduce the crushed matter in grain size thereby increasing an efficiency percentage of the quenched slag S to be reclaimed as the fine particles 33.

In this embodiment,positions where the crushed material are returned by way of the return route 76 and the sieve 80 for bulky matter separation is located may be assumed in a location other than the position shown in Fig. 5 as previously illustrated by Figs. 3 and 4.

It is to be understood that this invention is not to be limited to the specific embodiments shown. For example, a conveyor and a chute of any other type than means for conveying the particulates from the water quenching granulator 3 and the sieve 30 to the pulverizer 45 and the like. Further,the particulate exhaust port of the machine or the mechanism upstream the equipment may be disposed to directly face or to be connected to the particulate inlet of the equipment downstream the equipment. Furthermore, the furnace l, granulator 3, magnetic separator 20, sieves 30 and 80, pulverizer 45, and the crusher 70 and the like may be take any other type than those hereinbefore referred to while the screen may be of any other opening size than the size as above referred to.

According to the present invention described in Clam 1, the crusher is adapted to introduce only the fine particle parts screened by the sieve to prevent the ceramic pulverizing parts inside of the pulverizer from being broken.

According to th present invention stated in Claim 2,the coarse particle slag with metal are crushed by the

crusher and magnetically selected through th return route after separating the quenched solids into the slag and the metal by the magnetic separator so that th quenched solids may be efficiently separated into the two to increase the efficiency percentage thereof.

According to the present invention described in Claim 1 or 2,the bulky matter such as massive quenched metal and the pieces of the broken electrode are screened by the sieve to prevent the processing equipment from being blocked and broken.

Claims

1. Apparatus for solidifying and processing a molten material from a waste material melting furnace, characterized by comprising:

   a water quenching granulator (3) for a molten material discharged from a discharge port (2) of a waste material melting furnace (1);
   a magnetic separator (20) for separating magnetic materials from water granulated solids discharged from a discharge port (8) of said water quenching granulator (3);
   a sieve (30) for screening non-magnetic materials discharged from a discharge port (28) therefor in said magnetic separator (20) to separate into coarse particles (32) and fine particles (33);
   and a pulverizer (45) for further pulverizing said fine particles (33) discharged from a discharge port (37) therefor in said sieve (30), said pulverizer being provided therein with pulverizing parts made of ceramic.

2. Apparatus as claimed in claim 1, characterized by a crusher (70) for crushing said coarse particles (32) discharged from a discharge port (35) therefor in said sieve (30), and in which a return passage (76) is provided to return crushed materials discharged from a discharge port (71) therefor in said crusher to a path from said discharge port (8) of said water quenching granulator (3) to an inlet of said magnetic separator (20).

3. Apparatus as claimed in claim 1 or 2, characterized in that a sieve (80) for bulky matter separation is disposed on a path from said discharge port (8) of said water quenching granulator (3) to an inlet of said magnetic separator (20).

Fig. 1

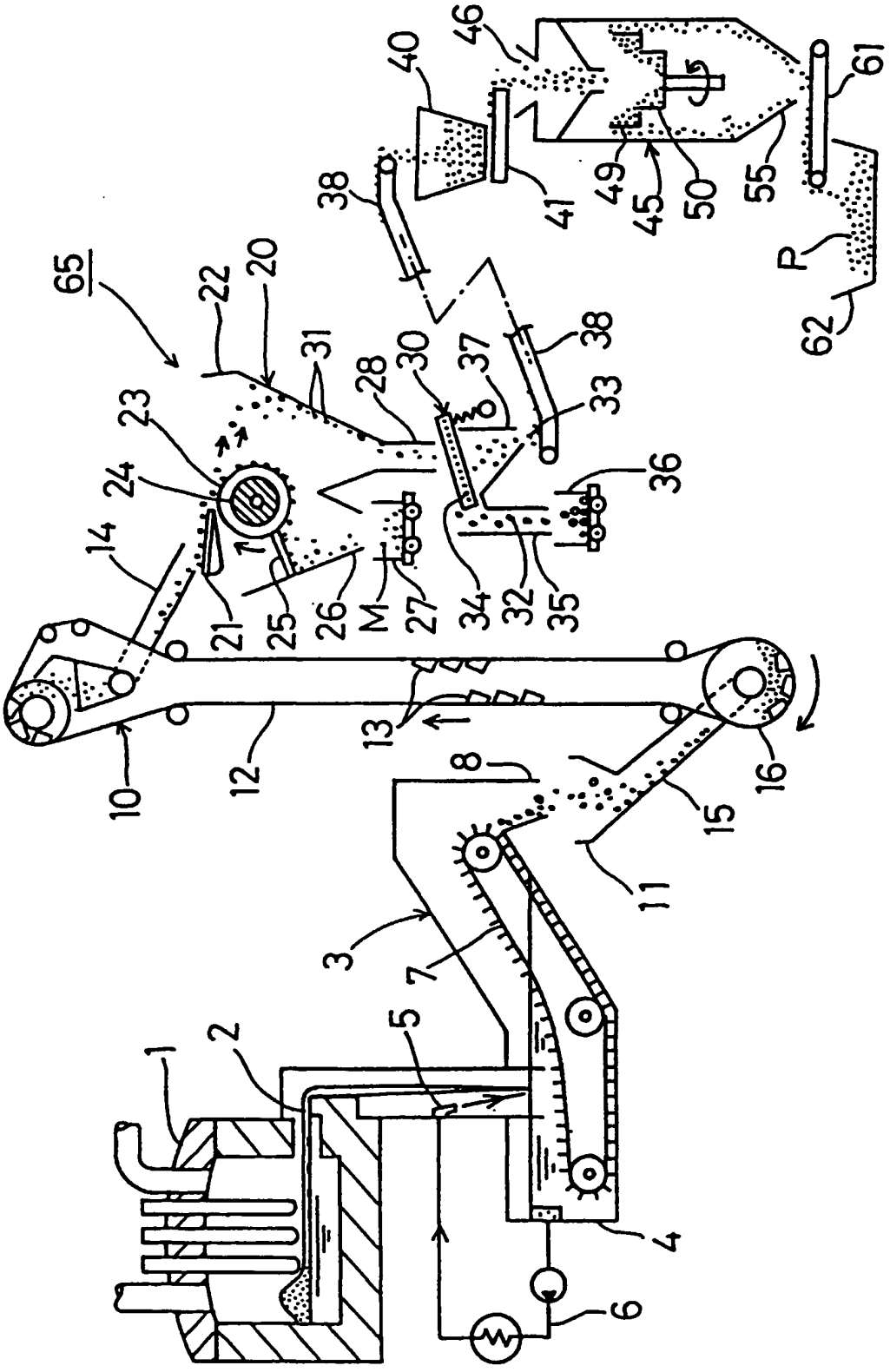
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Fig. 2

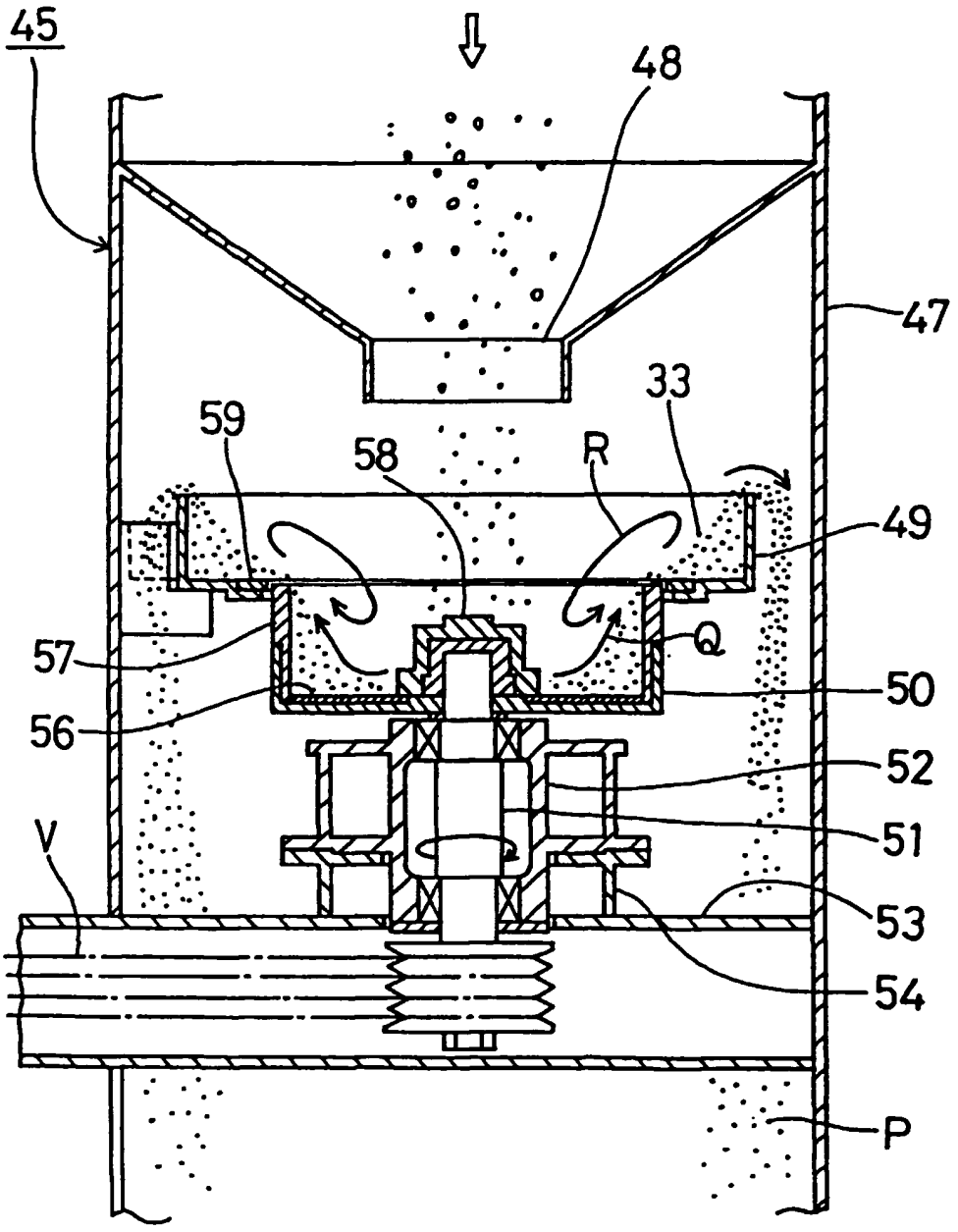

Fig. 3

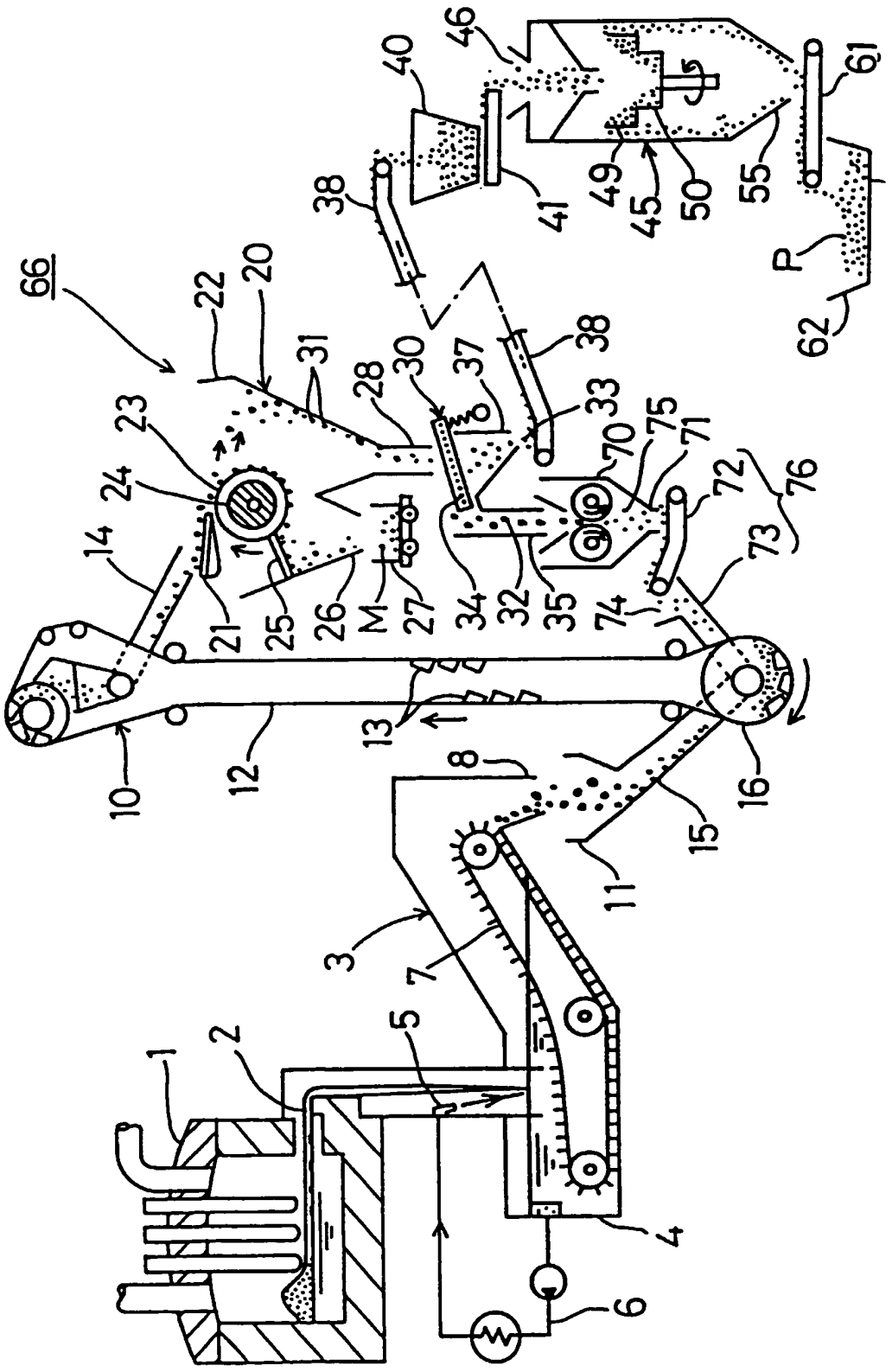
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Fig. 4

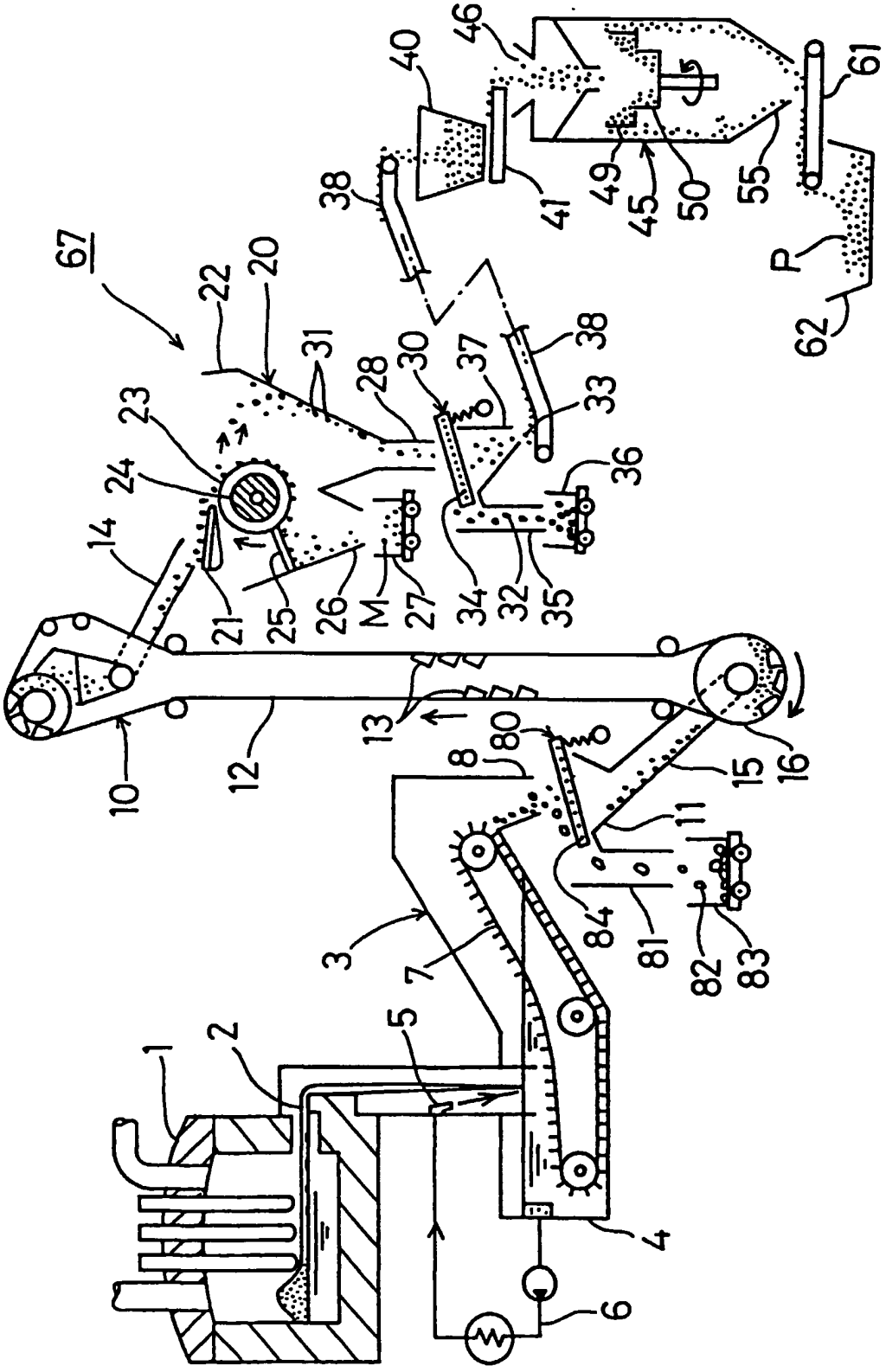
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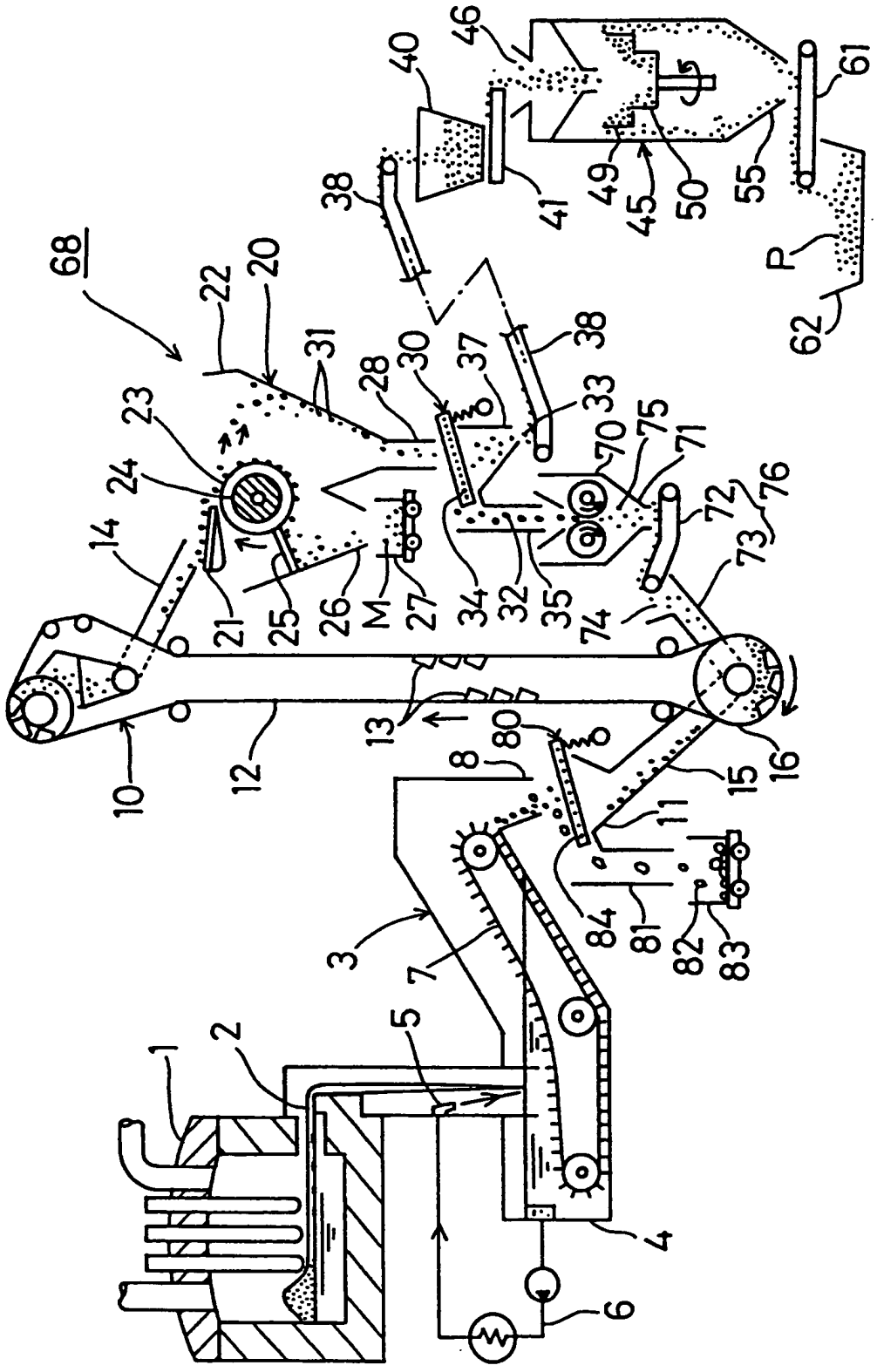
Fig. 5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European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 96 30 9326

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
Y,D	JP 62 172 107 A (DAIDO STEEL CO LTD) * figures 1,2 * & PATENT ABSTRACTS OF JAPAN vol. 012, no. 010 (M-658), 13 January 1988 & JP 62 172107 A (DAIDO STEEL CO LTD), 29 July 1987, * abstract *	1	B03B9/04 C22B7/04
Y	JP 06 063 690 A (TOYOTA MOTOR CORP ET AL.) * figure 1 * & PATENT ABSTRACTS OF JAPAN vol. 018, no. 302 (M-1618), 9 June 1994 & JP 06 063690 A (TOYOTA MOTOR CORP;OTHERS: 01), 8 March 1994, * abstract *	1	
A	JP 59 222 537 A (SHIN NIPPON SEITETSU KK ET AL.) * figure * & PATENT ABSTRACTS OF JAPAN vol. 009, no. 091 (C-277), 19 April 1985 & JP 59 222537 A (SHIN NIPPON SEITETSU KK;OTHERS: 01), 14 December 1984, * abstract *	1	TECHNICAL FIELDS SEARCHED (Int.Cl.6) B03B C22B
A	US 4 436 138 A (T. KONDO) * claim 1; figure *	1	
A	EP 0 429 298 A (TIDCO GROUP LIMITED) * column 3, line 20 - line 25 *	1	
A	US 2 971 703 A (F. E. RATH) * claim 1 *	1	
A	EP 0 691 160 A (ABB RESEARCH LTD.) * figure *	1	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	28 April 1997	Sutor, W

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
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E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

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